Weather

4-4 The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

4-4.1 Summarize the processes of the water cycle (including evaporation, condensation, precipitation, and runoff).
Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have not been introduced to the concept of the water cycle although parts of it should be familiar. In 2nd grade (2-3.2), students recalled forms of precipitation as rain, snow, sleet, hail. In 3rd grade (3-4.2), students explained the processes of evaporation and condensation. Runoff is a new concept but can be related to the 3rd grade (3-3.8) material on weathering and erosion by water as it changes the land. Students will further develop this concept in 6th grade (6-4.2) including transpiration, an additional form of precipitation along with the conditions needed to form each type of precipitation, and surface-water along with ground-water flow. In 7th grade (7-4.5), students will further investigate runoff as surface water.

It is essential for students to know that water changes form and cycles between Earth's surface and the air and back again. The components of the *water cycle* process include:

Evaporation
- Liquid water on Earth becomes a gas, called *water vapor*, as part of the air through the process of evaporation.
- The process of evaporation results from the Sun's energy.

Condensation
- Condensation happens in the air as water vapor changes back to droplets of water. Clouds form as a result of condensation; *dew* also forms from condensation, but the water droplets condense directly onto a surface such as grass, a car, or glass.
- The process of condensation results from the cooling of air temperature.

Precipitation
- After condensation occurs allowing for the forming of clouds, any form of water that falls from the clouds is called precipitation (rain, snow, sleet, hail).
- Snow, sleet, and hail result from freezing temperatures in the air; rain forms when the air temperature is above freezing.

Runoff
- If precipitation falls on land surfaces, it attempts to return to the ocean or lakes as runoff.

It is not essential for students to know the process of transpiration from plants or the movement of water through the groundwater system.

Assessment Guidelines:
The objective of this indicator is to *summarize* the processes of the water cycle; therefore, the primary focus of assessment should be to generalize information about the parts of the water cycle. However, appropriate assessments should also require students to *identify* individual parts of the cycle; *illustrate* parts of the cycle using words, pictures, or diagrams; or *classify* by sequencing the cycle.

Weather

4-4 The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

4.4.2 Classify clouds according to their three basic types (cumulus, cirrus, and stratus) and summarize how clouds form.
Taxonomy level: 2.3 and 2.4-A, B Understand Factual and Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-3.1), students recognized clouds as a feature of the day and night sky. In 2nd grade (2-3.5), students used pictorial weather symbols to record sky conditions. In 6th grade (6-4.3), students will classify shapes and types of clouds according to elevation and their associated weather conditions.

It is essential for students to know that there are three basic types of clouds. These clouds can be classified based on their observable characteristics.

Cumulus
- Puffy, lumpy-looking clouds often with a flat bottom.
- When cumulus clouds are dark they usually bring rain; white cumulus clouds do not bring rain.

Cirrus
- High, thin, wispy clouds.
- They are formed mostly of ice crystals.
- Cirrus clouds are most often associated with fair weather.

Stratus
- Layers of clouds that spread out covering a large area.
- Stratus clouds are often lower in the sky.

The formation of clouds happens when water vapor in the air rises, cools and condenses (or moves from a warm place to a cool place and condenses), forming the water droplets that make up a cloud. A cloud is a collection of tiny, liquid water droplets not water vapor gas.

It is not essential for students to know the combination of cloud names.

Assessment Guidelines:
The objective of this indicator is to *classify* clouds types; therefore the primary focus of assessment should be to determine the cloud type based on the description. However, appropriate assessments should also require students to *recognize* clouds; or *illustrate* clouds using pictures or words.

Another objective of this indicator is to *summarize* how clouds form; therefore, the primary focus of that assessment should be to generalize the major points about the process of the forming of clouds. However, appropriate assessments should also require students to *recall* what a cloud is; or *classify* by sequencing how clouds form.

Weather

4-4 The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

4.4.3 Compare daily and seasonal changes in weather conditions (including wind speed and direction, precipitation, and temperature) and patterns.
Taxonomy level: 2.6-B Understand Conceptual Knowledge

Previous/Future knowledge: In kindergarten (K-4), students demonstrated an understanding of seasonal weather changes. In 2nd grade, students recalled weather terminology, including temperature, wind speed and direction, and precipitation (2-3.2) and illustrated the weather conditions of different seasons (2-3.3). In 6th grade (6-4.4), students will summarize the relationship of the movement of air masses, high and low pressure systems, and frontal boundaries to storms.

It is essential for students to know that daily changes in weather result from changes in weather conditions, including temperature, wind speed and direction, and precipitation.

Temperature The condition of how hot or cold the air is at a given time

Wind speed The condition of how fast the wind is moving

Wind direction The condition determined by where the wind is coming from

Precipitation The condition of the type of water falling to Earth from the clouds

- As the seasons of the year change, temperature changes may cause precipitation changes; winds blowing from the north may bring colder air than winds blowing from the south or west.−
- One day's weather conditions can be compared to another in the same season, or compared to daily weather that occurs in different seasons.
- Examples of weather conditions are fair weather, showers or light rain, clear skies with cold temperatures, days of clouds and precipitation, or windy fair days or windy stormy weather; however, the comparisons should be related to the four conditions in the indicator.
- Weather patterns involve weather conditions that are repeated due to the season of the year. For example, summer temperatures are generally warmer than winter temperatures.

It is not essential for students to know air pressure or humidity conditions. Weather related to different types of fronts or air masses is not expected at this grade level.

Assessment Guidelines:
The objective of this indicator is to *compare* daily and seasonal weather conditions and patterns; therefore, the primary focus of assessment should be to compare conditions from one day to another or one season to another and also to compare weather conditions in a season one year to the next. However, appropriate assessments should also require students to *identify* a particular weather condition or seasons of the year based on the weather conditions; or *exemplify* conditions that would occur at a particular season.

Weather

4-4 The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

4.4.4 Summarize the conditions and effects of severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) and related safety concerns.
Taxonomy level: 2.4-B Understand Conceptual Knowledge

Previous/Future knowledge: In 2nd grade (2-3.6), students identified safety precautions that one should take during severe weather conditions. They have not been introduced to the specific conditions related to thunderstorms, hurricanes, and tornadoes, nor to the effects of those storms. In 6th grade (6-4.4), students will summarize the relationship of the movement of air masses, high and low pressure systems, and frontal boundaries to storms (including thunderstorms, hurricanes, and tornadoes) and other weather conditions.

It is essential for students to know that the weather conditions associated with severe weather are different for each type of storm. These conditions have different effects and there are safety concerns associated with each condition. Three types of severe weather include:

Thunderstorm
- A severe storm with lightning, thunder, heavy rain and strong winds.
- Hail may also form. Some examples of the effects of thunderstorms may be: heavy rains can cause flooding; lightning can cause fires; strong winds can blow over trees or power lines.

Tornado
- A small, funnel-shaped cloud that comes down from a storm cloud with winds spinning at very high speeds.
- Some examples of the effects of tornadoes may be: high winds can tear apart buildings; every time it touches the ground, it destroys everything in its path.

Hurricane
- A large storm that forms over warm ocean water with very strong winds that blow in a circular pattern around the center, or eye, of the storm.
- Some examples of the effects of hurricanes may be: high winds can blow over trees, power lines, and even buildings; heavy rain can cause flooding; the storm waves on the ocean can come in at the beach and damage the coastal area;

There are safety concerns related to these storms because of their conditions and effects. Some examples of these safety concerns may be:
- During a thunderstorm, stay inside if possible; stay out of the water; and do not stand under trees.
- During a tornado, find a safe place away from window; if you cannot find shelter lie flat in a ditch or other low place; and do not stay in your car.
- During a hurricane, board up windows in your house; stay away from windows; and move further inland if you are near the coast.

It is not essential for students to know how these storms form.

Weather

4-4 The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

Assessment Guidelines:

The objective of this indicator is to *summarize* severe weather phenomena and related safety concerns; therefore, the primary focus of assessment should be to generalize the main points in the description of the conditions and effects of these storms and to generalize safety issues related to these storms. However, appropriate assessments should also require students to *identify* the three mains types of severe storms; *exemplify* severe weather safety procedures for each type of storm; *compare* different types of severe weather phenomena; or *classify* different types of severe weather phenomena.-

Weather

4-4 The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

4.4.5 Carry out procedures for data collecting and measuring weather conditions (including wind speed and direction, precipitation, and temperature) by using appropriate tools and instruments.
Taxonomy level: 3.2-C Apply Procedural Knowledge

Previous/Future knowledge: Only the anemometer is a new instrument to this study of weather. In 2nd grade (2-1.2, 2-3.4), students used a thermometer to measure temperature, a rain gauge to measure precipitation, and a windsock or wind vane to determine wind direction. Wind speed was determined by using the Beaufort scale in 2nd grade (2-3.4). In 6th grade (6-4.5), students will use appropriate instruments to collect weather data (including wind speed and direction, air temperature, humidity, and air pressure).

It is essential for students to carry out procedures for collecting and measuring weather conditions in order to understand daily weather conditions. Weather data must be collected and read accurately using appropriate instruments:

Wind Speed
- Wind speed is measured with an *anemometer* as the wind causes the cups to spin.
- As the cups spin, the anemometer counts how many times they spin in a given period of time.
- The more turns, the faster the wind speed.

Wind Direction
- Wind direction is determined with a *wind (weather) vane*.
- Wind direction is described by the direction from which the wind is blowing.

Precipitation
- Amount of precipitation is measured in a *rain gauge*.
- Markings on the side show how much rain has fallen.
- A rain gauge measures rainfall in inches.

Temperature
- Air temperature is measured using a *thermometer*.
- The scale may be read in degrees Fahrenheit or Celsius.

It is not essential for students to make any of these instruments (but in some cases they can), or to use a sling psychrometer, barometer, or hygrometer.

Assessment Guidelines:
The objective of this indicator is to *use* instruments to collect and measure weather data; therefore, the primary focus of assessment should be to apply a procedure to the tool that would be needed to measure wind speed, wind direction, precipitation amounts, and air temperature. However, appropriate assessments should also require students to *identify* weather instruments that measure certain weather conditions; *interpret* the reading on the instrument for accurate data; or *interpret* the scale on a thermometer or rain gauge.

Weather

4-4 The student will demonstrate an understanding of weather patterns and phenomena. (Earth Science)

4-4.6 Predict weather from data collected through observation and measurements.
Taxonomy level: 2.5-B Understand Conceptual Knowledge

Previous/Future knowledge: Students have not done any weather predicting in previous grades. In 2nd grade (2-3.3), students illustrated the weather conditions of different seasons. In 6th grade (6-4.6), students will predict weather conditions and patterns based on weather data collected from direct observations and measurements, weather maps, satellites, and radar.

It is essential for students to know that using data collected through daily or long term observations and measurements, patterns in weather can be seen. Weather predictions are based on qualitative and quantitative collected data; they are not just guesses.

- Some weather signs can be seen by looking at clouds (4-4.2).
- Changes in wind speed or wind direction can indicate storms or temperature changes.
- Meteorologists interpret information from a variety of sources and use those sources to make predictions. The information they use is shown on a weather map.
- Weather maps may show large masses of warm or cold moving air. Lines between the air masses are called *fronts*.
  - When a warm front passes over an area, the air temperature increases.
  - When a cold front passes over an area, the air temperature decreases.
- Data related to temperature and precipitation can also be found on a weather map.

It is not essential for students to know how to read weather map data related to air pressure, how fronts form, how the air masses move in each type of front, stationary or occluded fronts, how to interpret station models, or how to track a hurricane from data.

Assessment Guidelines:
The objective of this indicator is to *predict* weather from data collected through observation and measurements; therefore, the primary focus of assessment should be to take data collected by students or professionals and use that information to show what the weather might be. However, appropriate assessments should also require students to *interpret* some basic information (temperature, precipitation, cold/warm front, sky conditions) on weather maps using a key; or *infer* weather conditions from collected weather data.